Space Weather Technical Forecast

Issued on Wednesday, 01 December 2021 at 01:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storm activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low, with all X-ray flare activity below C-class. There are currently five numbered sunspot regions on the visible disc. AR2898 and AR2900 are both located in the southwest quadrant. AR2901 in the northeast. AR2902 in the northern hemisphere near centre disc and AR2903 in the southeast quadrant. All sunspot regions show indications of simplifying, with a continued chance of C-class and very slight chance of M-class flares, mainly from AR2900. There was one filament eruption from the south Meridian at around 29/0745 UTC. This is currently analysed to have a slight Earth-directed component, arriving on 2nd December. No other Earth-directed CMEs were evident in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed measured by DSCOVR at L1, was initially at ambient levels, but with a general increasing trend from around 30/1300 UTC, rising to slightly elevated with a maximum speed of 480 km/s at 30/2320 UTC. Density was generally average 5-10 ppcc until 30/1300 UTC when it began to rise to above average, with a maximum density recorded at 30/1930 UTC of 40ppcc. The Interplanetary Magnetic Field (IMF), Bt, was weak until 30/1630 UTC, after which it became generally moderate with a peak of 15-16nT during the evening. The north-south component of the field (Bz), was also unremarkable initially, but after 30/1630 UTC it began to fluctuate between moderately positive and negative between +9/-13nT. The phi angle transitioned from positive (away from the Sun) to negative (toward the Sun), crossing around 30/1300 UTC, with further periods of positive (away from the Sun) during the evening. Geomagnetic Activity was Quiet (Kp 0-1) through much of 30th, before rising to Unsettled to G1/Minor Storm (Kp3-5) by the end of the day UTC, likely indicating the early arrival of a HSS from CH25/+ or CH26/+.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2 MeV) as observed by GOES-16 was predominantly at background to moderate levels, with a diurnal peak of 341 pfu at 30/1720 UTC. The associated 24-hour integrated fluence remained well below the Active threshold (1e8 integrated pfu), on a slight rising trend, with 5.29e6 integrated pfu recorded at 01/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain predominantly Very Low, with a chance of C-class flares, primarily from AR2900. There is a very slightly above background (5%) chance of M-class flares.

Solar Wind / Geomagnetic Activity: Continued enhancements from various coronal hole fast winds are expected through the period, including CH26/+ on day 1 (1st), then CH27/+ likely on day 2 or during day 3 (2nd or 3rd), with lingering effects lasting into day 4 (4th). A filament eruption which left the Sun on the 29th, may also bring a brief elevation to solar wind speeds during day 2 (2nd) as Earth encounters a glancing blow. Geomagnetic activity is expected to be mostly Quiet to Unsettled, but with periods of Active and a daily chance of G1/Minor Storm

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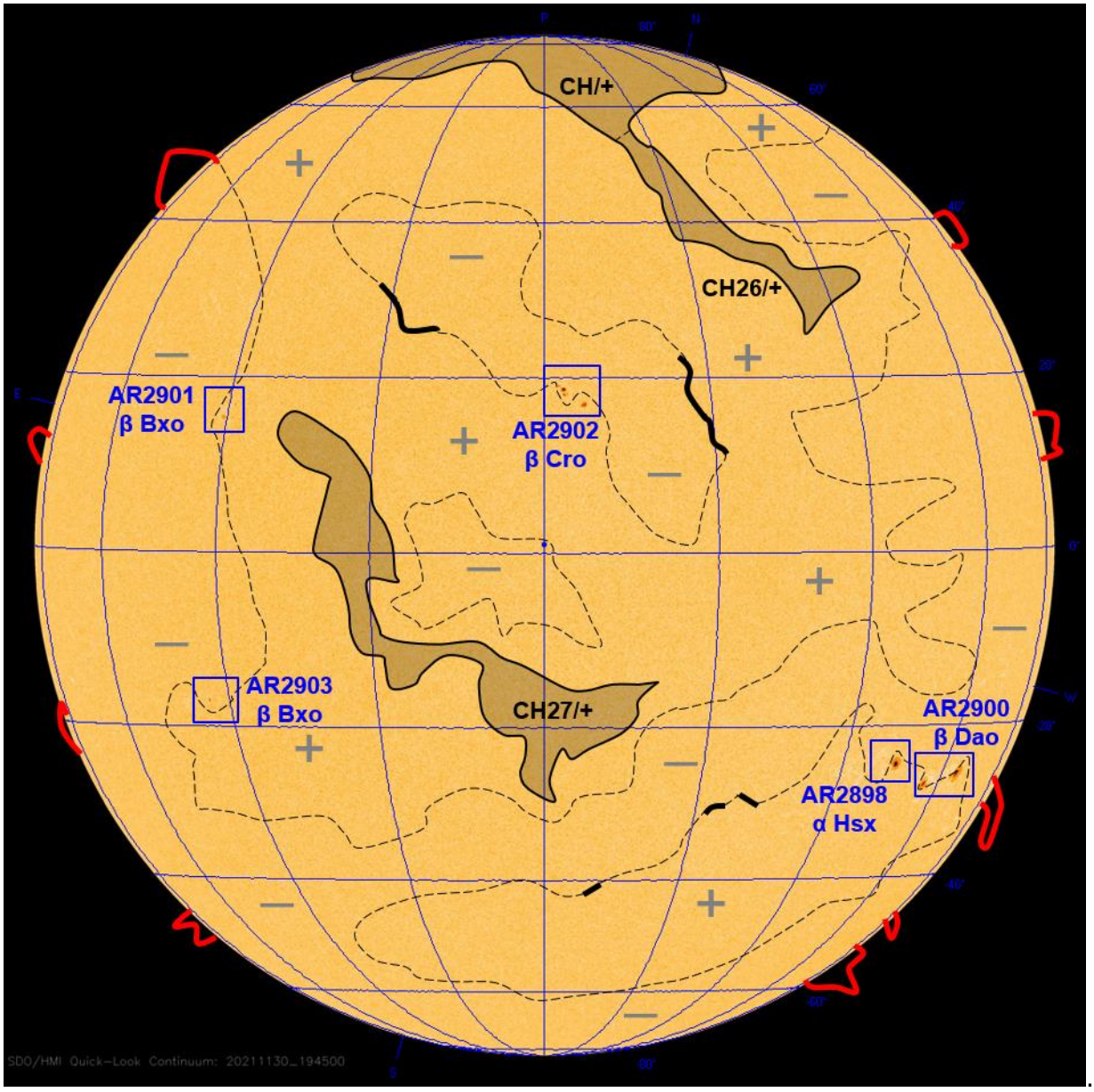
intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. The high energy electron flux (greater than 2 MeV) is likely to be at background to moderate levels, with the next notable enhancement likely to be from the arrival of the faster winds from CH27 on day 2 or 3 (2nd or 3rd). If this occurs, the fluence may rise as a result, but it is currently expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 30/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption which left the south centre disk of the Sun on the 29th may bring a brief elevation to solar wind speeds during 2nd December as we encounter a glancing blow, though the majority of the ejecta is expected to go below the Earth. There are no other Earth directed CMEs in the forecast.

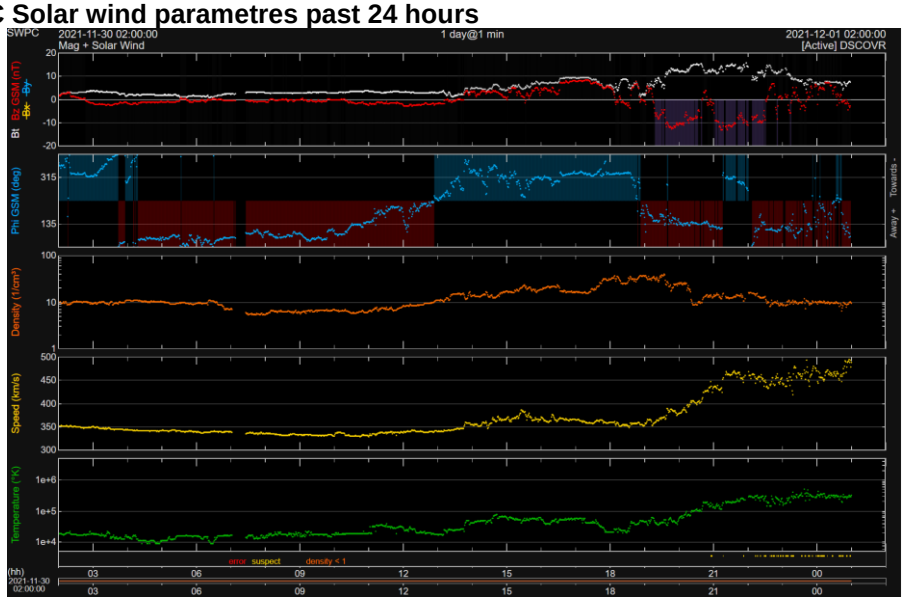
The solar wind parameters indicate the arrival of CH26/+ was during the evening of 30th November. There are expected to be lingering but waning effects from CH26/+, perhaps combined with CH25/+ during the first part of 1st December, though with no further significant impacts expected.

CH27/+ appears to be a more notable feature, and whilst its fast wind is not expected to arrive until 2nd or 3rd December, there is the potential for a very fast solar wind (near 700 km/s, which has been observed from some coronal holes in the southern disc during the last month). Enhanced observed solar winds from STEREO-A on 29th may also indicate potential faster solar winds from this feature reaching Earth on 2nd.

Consequently geomagnetic activity is expected to be mostly Quiet to Unsettled, but with periods of Active likely and a daily chance of G1/Minor Storm intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	30	40	40	20
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

Figure 2:SWPC Solar wind parametres past 24 hours



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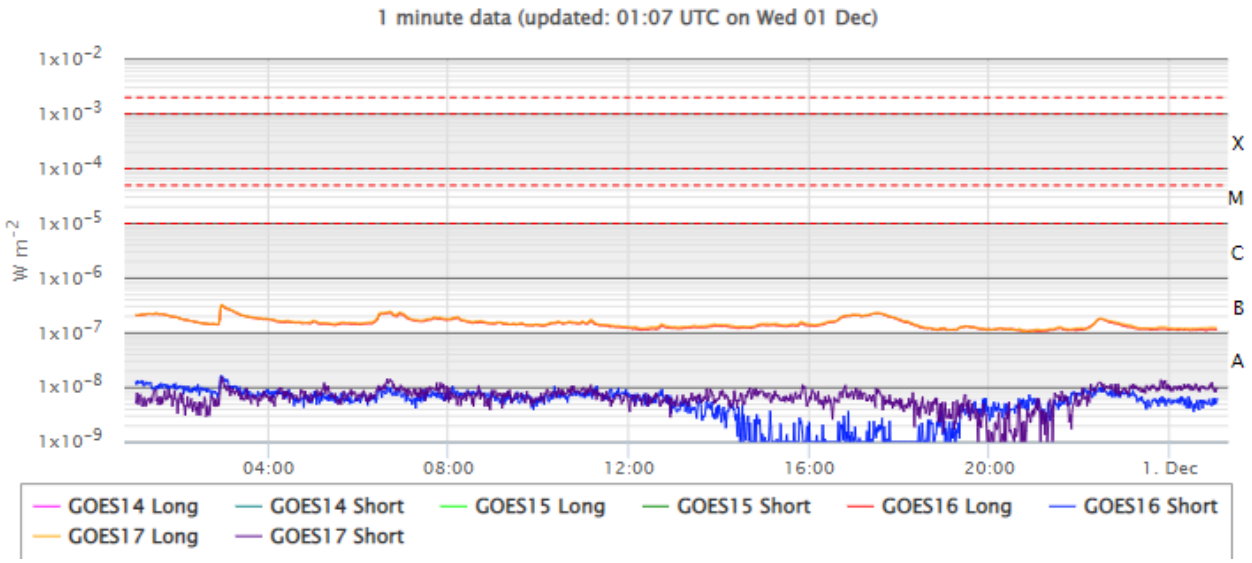
Radio Blackouts - X-Ray Flares:

There are five numbered sunspot regions on the visible disc. AR2898 and AR2900 are both located in the southwest quadrant. The largest and most complex spot is AR2900, there has been a slight reduction in areal extent recently, with the region comprising the two moderately sized leader and trailer spots. AR2898 continues to simplify, now a Hsx, and reduce in size. AR2901 in the northeast quadrant has been reclassified but remains small and simple, now a Bxo/Beta. 2902 in the centre north disc, has shown little chance in recent hours, still a Beta magnetic configuration with rudimentary penumbra. Finally, 2903 in the southeast quadrant, remains a simple Bxo/Beta group but is becoming increasingly faint.

Solar activity is likely to remain Very Low or Low, with a chance of C-class flares, most probably from region AR2900 in the southwest at present, with a very slight chance of an M-flare (5%).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Xray trace past 24 hours



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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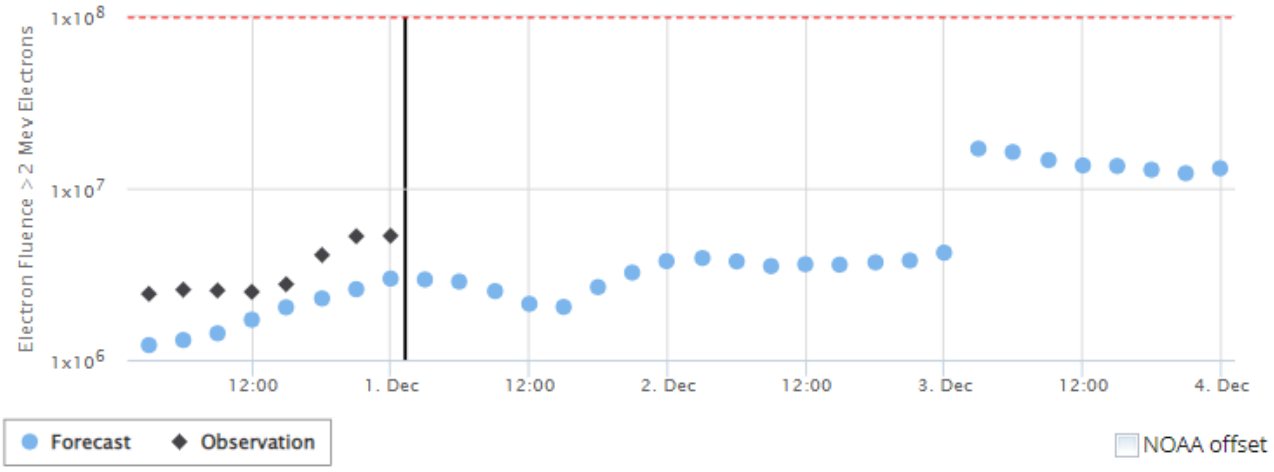
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed by GOES-16 at GEO has been at background to moderate levels during the last 24 hours, and is expected to continue at similar levels until a connection to a faster stream of solar wind occurs. The next potential enhancement is likely to be from the faster wind of CH27 from day 2 (2nd) possibly increasing diurnal maximum levels to High by the end of the period, however confidence is low.

With flux likely to remain below the High level until later in the period, the associated 24 hour integrated fluence is expected to remain below the Active threshold, with a general rising trend but only a slight chance of rising above at the end of the period. This is supported by REFM which maintains fluence levels at well below the Active threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM Integrated flux (fluence) observations and forecast.



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